Available online at www.sciencedirect.com
ScienceDirect
Procedia - Social and Behavioral Sciences 116 (2014) 3115 – 3119
Procedia
Social and Behavioral Sciences

5th World Conference on Educational Sciences - WCES 2013

The effect of video-assisted conceptual change texts on 12th grade students' alternative conceptions: The gas concept

Ayşegül Aslan *, Gökhan Demircioğlu

Karadeniz Technical University, Fatih Faculty of Education, Department of Secondary Science Education, Trabzon, , 61335, Turkey

Abstract

The purpose of the study was to investigate the effect of video-assisted conceptual change texts on 12th grade students' understanding and alternative conceptions concerning the gas concept. Within the quasi-experimental design, the study was conducted with 41 12th grade students who were willing to participate in the study. In the design, one experimental group (N = 19) who is taught by using Video-Assisted Conceptual Change Texts and one comparison group (N = 22) who is taught in a traditional manner were used. Students' understanding and alternative conceptions of gas concept were evaluated with a pretest/posttest research design using a true-false test which is consisted of 29 statements. Statistical tests indicated that the test is reliable (with KR-20 reliability of 0.76). The analysis of the findings revealed statistically significant differences between the experimental and comparison groups with respect to conceptual understanding of the gas concept after the treatment. In addition, the findings indicated that each group showed progress in eliminating their alternative conceptions, but the experimental groups were better overall. In conclusion, it was suggest that Video-Assisted Conceptual Change Texts may be an effective way for teaching the gas concept and curriculum designers and textbook writers should take into consideration these strategies when developing new science curriculum. For further work, similar studies can be constructed for other chemistry topics or concepts with larger sample sizes.

Keywords: Conceptual change text, gases, chemistry education, video

1. Introduction

The research in science education indicates that students develop their own ideas about basic science concepts before coming to science classes. Frequently, these ideas are different from accepted scientific knowledge (Driver et al., 1994; Demircioğlu, 2009). "Misconceptions", "alternative structures", "sciences of children", "pre-concepts", "common sense concepts", "spontaneous information" or "inadequate understanding" are used to express these ideas

in the literature (Lind & Cheng, 2000). Although the science education literature consisted of a number of studies examining students' alternative conceptions concerning about science concepts, studies on how these alternative conceptions can be treated are still rare. The determination of alternative conceptions is important, but elimination of

* *Corresponding name:* Ayşegül Aslan *Tel.: +90-462- 377-6827 fax:+90-462-248-7344.*
E-mail address: aysgl.aslan@gmail.com

doi:10.1016/j.sbspro.2014.01.718

these alternative conceptions is more important (Christianson & Fisher, 1999). Meaningful learning of concepts involves reorganizing or replacing students' preconceptions to accommodate new ideas and this process has been called conceptual change (Smith, Blakeslee, & Anderson, 1993) The applications of conceptual change approach include analogies, explanatory models, concept change texts (CCT), refutational texts, animations, computer-assisted learning, group workings, demonstration experiments and discussion (Guzzetti, 2000). The conceptual change texts/refutational tests have often been used in the related literature. It was suggested that refutational texts are more effective on conceptual change instead of scientific text or expository text (Wandersee et. al., 1994; Akgün & Deryakulu, 2007). On the other hand, refutational text (RT) strategy was criticized because of providing new concepts to students directly. The conceptual change texts were recently preferred instead of refutational texts. Research in the literature showed that conceptual change texts were more effective in eliminating students' alternative conceptions than traditional teaching methods (Köse, Ayas & Uşak, 2006; Özmen & Demircioğlu, 2003). Besides the use of conceptual change texts, technologies based on computer can facilitate knowledge construction in the class (Williams et al., 2004). The computer-assisted instruction (CAI) is an important place in improving the teaching of difficult and abstract science concepts (Allessi & Trollip, 1991). Computer animations have been also used in science education to provide conceptual change (Ebenezer, 2001; Kelly & Jones, 2007; Windschitl & Andre, 1998). In the study, we used videos and conceptual change texts to provide conceptual change.

The purpose of the study was to investigate the effect of video-assisted conceptual change texts on 12th grade students' understanding and alternative conceptions concerning the gas concept. The specific research questions in this study were:

1- What are the experimental and control group students' alternative conceptions about gases both before and after the treatment?
2- Is there a statistically significant difference between the experimental group that studied video-assisted CCTs and the control group that was taught with traditional teaching in term of students' conceptual understanding of the gas concept?
3- Is there any effect of gender on students' conceptual understanding of the gas concept?

2. Methods

2.1. Participants

A non-equivalent pretest-posttest control group design was used in this study. The subjects for the study consisted of 41 twelfth grade students (19 and 22 students) from two intact classes of a high school on the north coast of Black Sea Region of Turkey. The students in both classes had similar educational and socio-economic backgrounds. One class (N = 19; 10 boys and 9 girls) was assigned as the experimental group (EG) and the other (N = 22; 10 boys and 12 girls) was assigned as the control group (CG). While the experimental group was taught by a teacher with 5 years of experience in teaching chemistry though video-assisted CCTs, the control group was taught by a teacher with 7 years of experience in teaching chemistry though a traditional approach which was strongly based on the teacher-centered instruction. When considered the teachers' educational backgrounds, it can be said that they had very similar experiences in teaching chemistry. The experimental group teacher was introduced to the conceptual change texts and to the teaching strategy before the treatment in order to be sure that the CCTs were used as it was planned. Besides, the first author observed all courses during the treatment. The unit "gases" in the high school chemistry curriculum consists of: a) general properties of gases; b) gas laws; c) density of gases; d) the mixture and kinetic of gases; e) factors effecting the number of collision.

2.2. Data collection tool

A true/false test consisting of 29 statements was used to determine students' conceptual understanding and alternative conceptions of the gas concept. Each statement in the test expressed an alternative conception from the related literature. The test template had a space by each question for the student to mark as True or False. Students' responses were classified as true and false. A student' total score was calculated giving 0 point for the wrong answer and 1 point for each correct answer. The maximum point of the test is 29. For the reliability and validity of the test, it was applied to 35 high school students from another high school. Cronbach alpha reliability coefficient of it was found as 0,67. In the study, concept achievement test is used as pre-test and post-test in relation with the general properties of gases.

3. Results and discussion

Percentages of alternative conceptions obtained from pre-test and post-tests have been given in Table 1. According to Table 1, while percentages of correct answers of experimental group students ranged from 16% to 100% in pre-test and ranged from 53% to 100% in post-test, those of experimental group students ranged from 15% to 100% in pre-test and ranged from 23% to 100% in post-test. When developing the conceptual change texts, we did not take into consideration all alternative conceptions determined with the true/false test used in the present study. We used only 7 of them.

Table 1. The percentages of correct answers of students in both groups for statements in both pre-test and post test

		Control grouP		Experımental group	
		pre-test	post-test	pre-test	post-test
	Statements in the test	%	%	%	%
1	Gas is an evaporated matter	23	50	26	89
2	The air is a gas which is consisted of gap.	77	68	79	68
3	The gases can be compressed.	100	100	95	100
4	Air is not included in the closed container	100	91	95	100
5	There is no other gas aside from oxygen in fresh air.	100	95	100	100
6	Air has no weight and mass.	100	91	89	95
7	When we take some amount gas from a sealed container filled up with oxygen the remaining oxygen rises up in the container.	50	50	42	89
8	Considering that the oxygen and nitrogen gases in a sealed container, the oxygen moves down and nitrogen remains above.	45	45	42	84
9	The air is an invisible object.	32	55	37	79
10	There is no particular form of air	100	95	100	100
11	There is no any gas in an open container.	100	86	89	95
12	The gas consist of much too small particles to observe with naked eye	91	77	95	84
13	The gas particles are randomly spread out in a closed container.	100	91	100	95
14	The gas particles exhibit their natural movement	15	40	21	65
15	The gases are lighter than the same material in its liquid or solid state	50	45	47	95
16	Gases are light and invisible such as air	50	45	63	100
17	Gases spread faster than air	73	73	68	68
18	The fluids are the gas below the critical temperature and the vapor above the critical temperature	45	59	63	89
19	The reason for expansion of balloon is to increase its flexibility.	82	77	79	89
20	In pressed container, the solubility of a gas solute in a water solvent decreases because a chemical reaction starts if its cover opens.	23	64	42	95
21	The density of the gases is smaller than solids and liquids	77	77	89	79
22	The reason for expansion of balloon with temperature is to increase the number of molecules per unit volume	60	27	68	74
23	Helium gas and hot air are the same	100	95	79	100
24	A mixture of gases that do not react with each other act as a single pure gas. For example: Air	60	82	84	89
25	The gases are hotter than liquids in the same setting	32	59	16	89
26	The air and the oxygen are the same gases.	100	77	100	100
27	The gaps between the gas particles are filled by materials such as dust, air and so on.	36	27	26	53
28	The size of gas particles change with temperature.	73	68	79	84
29	Gas molecules make elastic collisions.	82	91	95	95

However, other alternative conceptions are discussed with teacher oriented questions and class discussions during the treatment. In the light of these results, the general success has been increased among students with conceptual change texts. For example, 84% of students in experimental group and 68% of students in control group had the alternative conception (Item 25, Table 1) *"Gases are hotter than liquids in the same setting"* before the treatment. Although in the experimental group, this alternative conception was explained in detail in the explanatory text. 11% of students have still continued to hold the alternative conception. On the other hand, 41% of control group students continued to hold it after the treatment. The results obtained from the other alternative conceptions are also similar. This result supported the notion that it is not easy to eliminate alternative conceptions.

There is a significant increase from pretest to post-test after application. While the mean score of experimental group students increased 3.9 points from the pre-test to the post-test, that of control group decreased 0,1 point. As seen in Table 2, there is no significant difference between experiment group ($\overline{x}$= 20,9; SD = 2,8) and control group

($\overline{X}$ = 20,1; SD= 2,7) in terms of success after the treatment ($t_{(39)}$ = 0,928; p > 0,05). From this, it can be said that experimental group students' achievement and alternative conceptions are similar to that of control group. As there is no significant difference between groups, post-test means are also compared with the use of t-test. As seen in Table 2, there is a statistically significant difference between experiment group ($\overline{X}$ = 24,8, SD = 2,4) and control group ($\overline{X}$ = 20, SD = 3,2) with respect to the achievement ($t_{(39)}$=5,393, p <0,001).

Table 2. The results of the t-test on pre- and post-test scores of experimental and control group students

Tests	Group	N	Mean	S.D	df	t	p
Pre-test	**Experiment**	19	20,9	2,8	39	0,928	0,359
	Control	22	20,1	2,7			
Post-test	**Experiment**	19	24,8	2,4	39	5,393	0,000
	Control	22	20,0	3,2			

When the literature is checked, several studies about the effect of conceptual change texts on students' achievement and alternative conceptions were found. The results of these studies showed that teaching with conceptual change texts increases the students' conceptual understanding about science concepts and decreases their alternative conceptions (Chambers & Andre, 1997; Guzzetti et.al., 1997; Wang % Andre, 1991; Özmen et.al., 2009). The results of the present study are consistent with those of the studies in the literature.

4. Conclusion and suggestion

The present study investigated the effect of video-assisted conceptual change texts on 12th grade students' understanding and alternative conceptions concerning the gas concept. The results indicated that teaching with the video-assisted conceptual change texts based on the conceptual change strategy was more successful in overcoming students' alternative conceptions on the gas concept than the traditional instruction. This result supported the notion that it is not easy to dispel alternative conceptions just by using traditional instructional methods and was consistent with findings of similar studies in the literature. On the other hand, some of alternative conceptions of experimental group students are still encountered after the implementation. This indicates that video-assisted conceptual change texts also have failed to overcome some students' alternative conceptions towards scientific ones. For this reason, video-assisted conceptual change texts also needs to be integrated with some other effective teaching methods to be more effective in improving students' learning of gas concepts. Namely, researchers may also improve our approach by integrating new teaching methods into this cooperation.

Teachers should be aware of their students' alternative conceptions about the gas concept and its related concepts, because they are strong predictors of student achievement. They should be informed about the usage and importance of conceptual change texts based on conceptual change approach. In short, when suitable strategies are used in the teaching of the gas concept, they are more likely to cause a significantly better removal of alternative conceptions and acquisition of scientifically sound understanding. In addition, chemistry teachers should be encouraged to develop teaching materials concerning the other chemistry concepts in the light of the conceptual change model. The present study would be an important source for the chemistry teacher. On the other hand, the readability level of conceptual change texts certainly must be examined and texts should be as short as possible.

References

Akgün, Ö.E., & Deryakulu, D. (2007). Düzeltici Metin ve Tahmin-Gözlem-Açıklama Stratejilerinin Öğrencilerin Bilişsel Çelişki Düzeyleri ve Kavramsal Değişimleri Üzerindeki Etkisi, 40 (1), 17-40.

Allessi, S., & Trollip, S. R. (1991). Computer based instruction: Methods and development (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Chambers, S.K. ve Andre, T. (1997). Gender, prior knowledge, interest, and experience in electricity and conceptual change text manipulations in learning about direct current. *Journal of Research in Science Teaching, 34*, 107-123.

Christianson, R.G. & Fisher, K.M. (1999). Comparison of student learning about diffusion and osmosis in constructivist and traditional classroom. *International Journal of Science Education,* 21, 689-698.

Demircioğlu, G., (2009). Comparison of the effects of conceptual change texts implemented after and before instruction on secondary school students' understanding of acid-base concepts. *Asia-Pacific Forum on Science Learning and Teaching*, Volume 10, Issue 2, Article 5.

Driver, R., Squires, A., Rushworth, P. ve Wood-Robinson, V. (1994). *Making sense of secondary science: Research into children's ideas*. New York: Routledge.

Ebenezer, J. V. (2001). A hypermedia environment to explore and negotiate students' conceptions: Animations of the solution process of table salt. *Journal of Science Education and Technology*, 10(1), 73–91.

Guzzetti, B.J, Williams, W.O, Skeels, SA., ve Wu, S.M. (1997). Influence of text structure on learning counterintuitive physics concepts. *Journal of Research in Science Teaching, 34*, 701-719.

Guzzetti, B. J. (2000). Learning counter intuitive science concepts: What have we learned from over a decade of research? *Reading, Writing, Quarterly*, 16, 89–98.

Lin, H. ve Cheng, H. (2000). The assessment of students' and teachers' understanding of gas laws. *Journal of Chemical Education*, 77, 235–238.

Kelly, R. M., & Jones, L. L. (2007). Exploring how different features of animations of sodium chloride dissolution affect students' explanations. *Journal of Science Education and Technology*, 16, 413–429.

Köse, S.,Ayas, A., Uşak, M. (2006). Fen Bilgisi Öğretmen Adaylarında Fotosentez ve Bitkilerde Solunum Konularında Görülen Kavram Yanılgılarının Giderilmesinde Kavram Değişim Metinlerinin Etkisi. Pamukkale Üniversitesi, *Journal of Environmental and Science Education*, 1,1,78-103.

Özmen, H., & Demircioğlu, G. (2003). Asitler ve Bazlar Konusundaki Öğrenci Yanlış Anlamalarının Değerlendirilmesinde Kavramsal Değişim Metinlerinin Etkisi, Milli Eğitim Dergisi, 159.

Özmen,H,Demircioğlu, H. ve Demircioğlu, G. (2009). The effects of conceptual change texts accompanied with animations on overcoming 11th grade students' alternative conceptions of chemical bonding, *Computers & Education*, 52(3), 681-695.

Smith, L. E., Blakeslee, D. T., & Anderson, W. C. (1993). Teaching strategies associated with conceptual change learning in science. Journal of Research in Science Teaching, 30, 111–126.

Wandersee, J.H., J.J. Mintzes and J.D. Novak, 1994. Research on Alternative Conceptions in Science. In: Handbook of Research on Science Teaching and Learning, Gabel, D.L. (Ed.). Macmillan, New York, pp: 177-210.

Wang, T. ve Andre, T. (1991). Conceptual change text versus traditional text and application questions versus no questions in learning about electricity. *Contemporary Educational Psychology, 16*, 103-116.

Williams, M., Linn, M. C., Ammon, P., & Gearhart, M. (2004). Learning to teach inquiry science in a technology-based environment: A case study. Journal of Science Education and Technology, 13(2), 189–206.

Windschitl, M., & Andre, T. (1998). Using computer simulations to enhance conceptual change: The roles of constructivist instruction and student epistemological beliefs. Journal of Research in Science Teaching, 35(2), 145–160.